Embedded Solutions

MDIS™ Examples under Linux

MDIS4™/2004 System Package for Linux

Edition	Comments	Technical Content	Date of Issue
E1	First edition	T. Schnürer	2008-04-03

Application Note

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1 Introduction

The various possibilities of combining MEN hardware and software products sometimes makes it difficult to decide which packages are needed for a certain system or how the drivers can be built. Although the MDIS Wizard is taking a lot of difficult configuration tasks away from customers, there are some driver- and board-related configurations which currently cannot be configured in the MDIS Wizard.

This application note tries to show some examples of regular MDIS Wizard configured projects and also projects where manually predefined MDIS descriptor files and Makefiles are necessary.

It shall help customers – together with the MDIS under Linux user manual – to get their MDIS projects up and running in short time.

You can find all available downloads around the MDIS4/2004 system package for Linux, including project examples discussed in this document, on MEN's website. (Article no. 13M000-13.)

2 Example MDIS Projects

In this chapter the demo projects are introduced and built. If driver packages other than the MDIS system package are needed this is mentioned under headline 'Prerequisites'.

2.1 EM1 CAN

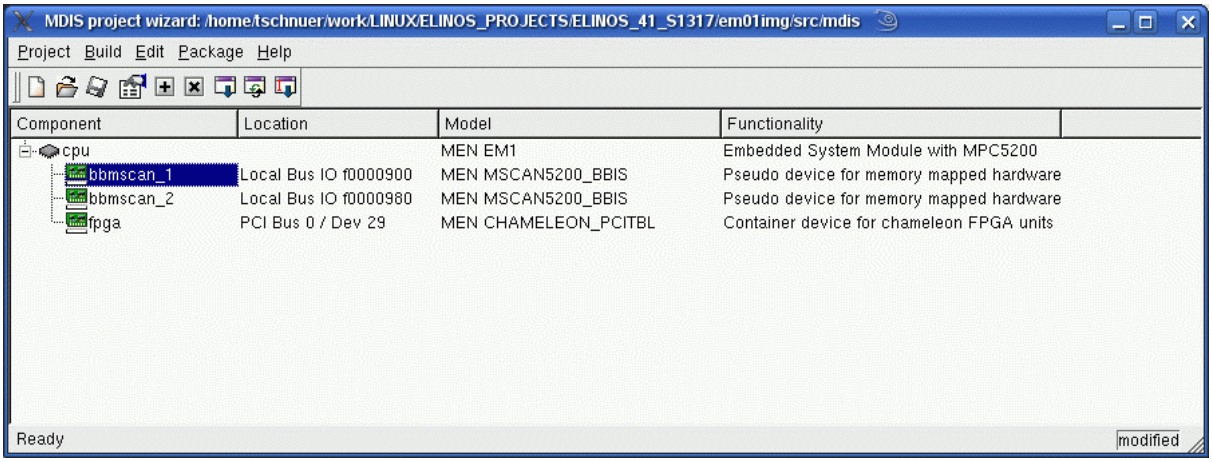
This project demonstrates how to access the MPC5200 on-chip CAN controllers. The driver is the MSCAN driver that supports the 16Z029_CAN FPGA IP core. The driver is used in two flavors within MDIS: as a driver for the on-chip CAN controllers and also as a driver for the 16Z029_CAN FPGA IP core that can be built into the EM1's on-board FPGA.

2.1.1 Creating the Project in MDIS Wizard

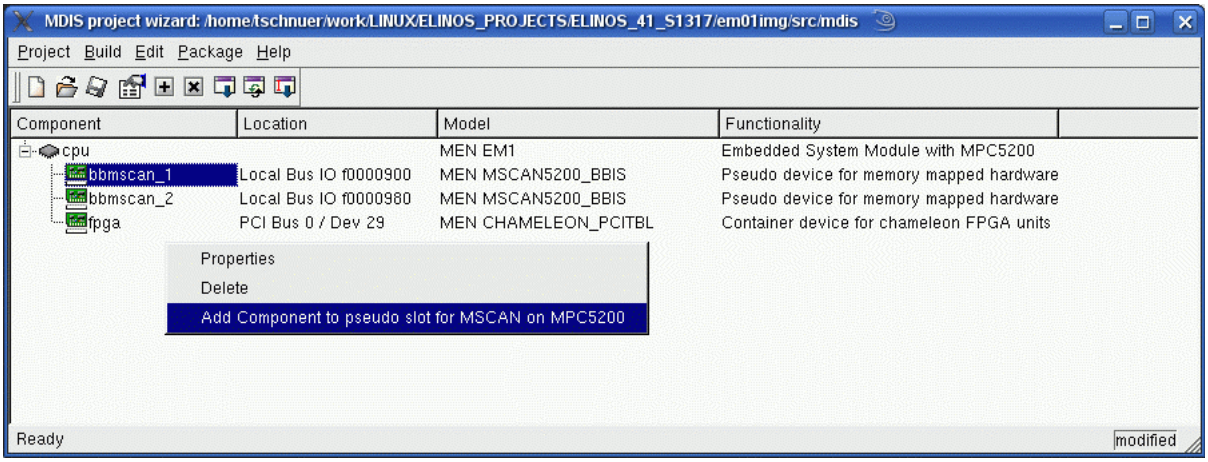
☑ Start the MDIS Wizard with command

```
/opt/menlinux/BIN/mdiswiz
```

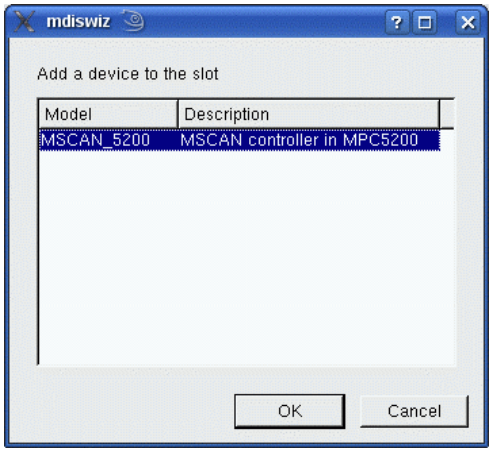
☑ Select an EM1 CPU board:


MDIS project wizard: /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis
Project Build Edit Package Help
Component Location Model Functionality
cpu MEN EM1 Embedded System Module with MPC5200
bbmscan_1 Local Bus IO f0000900 MEN MSCAN5200_BBIS Pseudo device for memory mapped hardware
bbmscan_2 Local Bus IO f0000980 MEN MSCAN5200_BBIS Pseudo device for memory mapped hardware
fpga PCI Bus 0 / Dev 29 MEN CHAMELEON_PCITBL Container device for chameleon FPGA units
Ready
modified

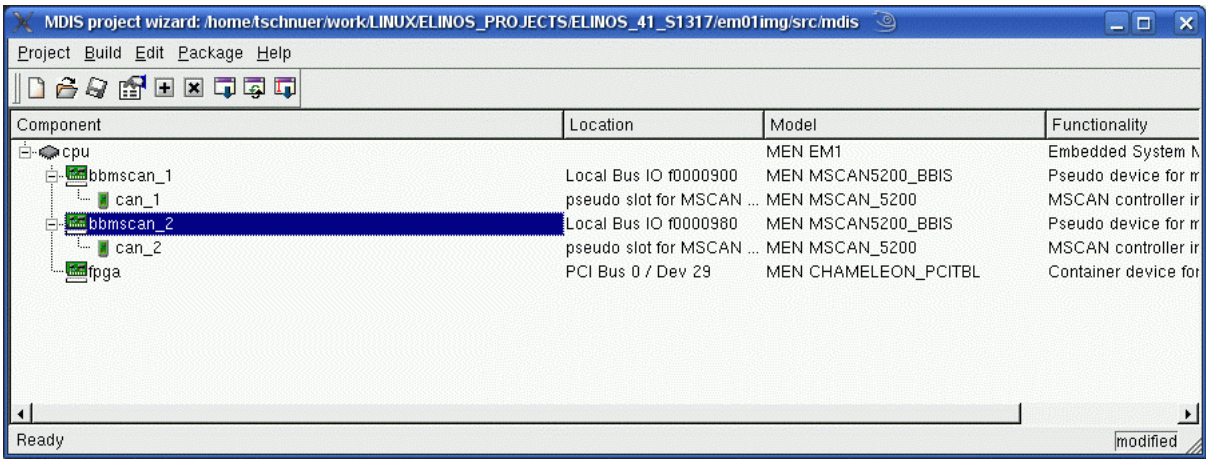
☑ Add the CAN driver to the two on-chip CAN ports:


MDIS project wizard: /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis
Project Build Edit Package Help
Component Location Model Functionality
cpu MEN EM1 Embedded System Module with MPC5200
bbmscan_1 Local Bus IO f0000900 MEN MSCAN5200_BBIS Pseudo device for memory mapped hardware
bbmscan_2 Local Bus IO f0000980 MEN MSCAN5200_BBIS Pseudo device for memory mapped hardware
fpga PCI Bus 0 / Dev 29 MEN CHAMELEON_PCITBL Container device for chameleon FPGA units
Properties
Delete
Add Component to pseudo slot for MSCAN on MPC5200
Ready
modified

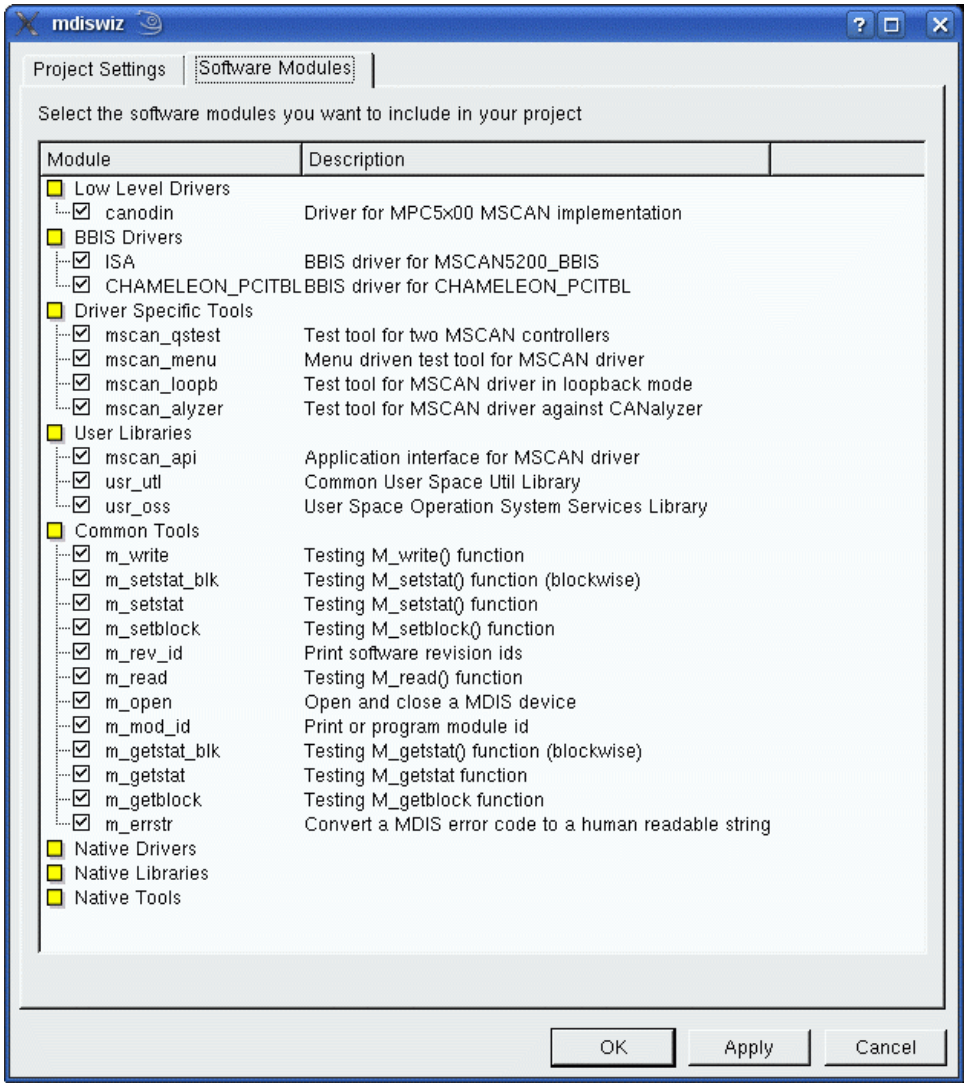
☑ Select the MSCAN_5200 driver component:



☑ Do this for both CAN controllers so the configuration looks as shown below:



☑ The Software Modules settings should look like this:



When the project is saved, the Makefile and the system description file *system.dsc* are generated and stored.

2.1.2 Building the Project and Installing Driver Files

When the project was created, the build can be started either from within MDIS Wizard or at the command line, which was used for this example. Mind that in the following build log examples many lines are omitted so the log does not fill numerous pages in this document. When lines of output are skipped this is marked through "[...]". The build logs are also available in the example project's ZIP archive. (See note on page 3 for hints on download of the example projects.)

☑ First, "source" the *ELINOS.sh* file created by ELinOS to set environment variables by calling it with a leading '.' as in the example below:

```
tslinux2:/home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img # . ELINOS.sh
STARTING ELINOS SESSION
=======================

Setting up CDK ppc_60x for glibc-2.3.4

$ELINOS_PREFIX     = /opt/elinos-4.1
$ELINOS_BOARD      = menem1
$ELINOS_BIN_PREFIX = ppc_60x
$ELINOS_BOOT_STRAT = uboot_multi
$ELINOS_KERNELPATH = men5200/linux-2.6.15
$ELINOS_PROJECT    = /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img
$ELINOS_DOSNAME    = em01img
$CC                = ppc_60x-gcc
$CXX               = ppc_60x-g++
$AS                = ppc_60x-as
$GDB               = ppc_60x-gdb
```

☑ Then, change into subdirectory */src/mdis* and execute *make*:

```
tslinux2:/home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img # cd src/mdis/
tslinux2:/home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis # make
Getting Compiler/Linker settings from Linux Kernel Makefile
 Cleaning
 .kernelsubdirs

++++++++ Preparing debug version of module men_mdis_kernel ++++++++++++
Directory OBJ/dbg/men_mdis_kernel created

++++++++ Preparing debug version of module men_bbis_kernel ++++++++++++
Directory OBJ/dbg/men_bbis_kernel created

++++++++ Preparing debug version of module men_oss ++++++++++++
Directory OBJ/dbg/men_oss created

++++++++ Preparing debug version of module men_dbg ++++++++++++
Directory OBJ/dbg/men_dbg created

++++++++ Preparing debug version of module men_desc ++++++++++++
Directory OBJ/dbg/men_desc created

++++++++ Preparing debug version of module men_pld ++++++++++++
Directory OBJ/dbg/men_pld created

++++++++ Preparing debug version of module men_pld_sw ++++++++++++
Directory OBJ/dbg/men_pld_sw created
[...]
```

```
++++++++ Preparing debug version of module men_ll_canodin ++++++++++++
Directory OBJ/dbg/men_ll_canodin created

++++++++ Preparing debug version of module men_bb_chameleon_pcitbl ++++++++++++
Directory OBJ/dbg/men_bb_chameleon_pcitbl created

++++++++ Preparing debug version of module men_bb_isa ++++++++++++
Directory OBJ/dbg/men_bb_isa created
++++++++ Building kernel modules +++++++++++
cat /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis/
.kernelsubdirs >>OBJ/Makefile
  LD      /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis/
OBJ/dbg/men_bb_chameleon_pcitbl/built-in.o
  CC [M]  /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis/
OBJ/dbg/men_bb_chameleon_pcitbl/bb_chameleon.o
  CC [M]  /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis/
OBJ/dbg/men_bb_chameleon_pcitbl/bb_module.o
  LD [M]  /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis/
OBJ/dbg/men_bb_chameleon_pcitbl/men_bb_chameleon_pcitbl.o
  LD
[...]

++++++++ Building mdis_createdev ++++++++++++
Directory OBJ/mdis_createdev created
Compiling mdis_createdev.c
Linking ../../BIN/mdis_createdev
make all_dev_tools

++++++++ Building descgen ++++++++++++
make[4]: Nothing to be done for `build'.
+
++++++++ Building descriptor system ++++++++++++
processing /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/src/mdis/
system.dsc
creating DESC/cpu.bin
creating DESC/fpga.bin
creating DESC/bbmscan_1.bin
creating DESC/can_1.bin
creating DESC/bbmscan_2.bin
creating DESC/can_2.bin
```

☑ Finally, the compiled driver files have to be installed in the root file system that is generated by ELinOS. Execute command *make install* at subdirectory */src/mdis*, or click on the *Install Project* button in the MDIS Wizard.

Furthermore it is necessary to make sure that the created files run on the root file system on the target, too. With the previous step the generated files were only more or less copied into the ELinOS project's subfolders */app.rootfs* and */kernel.rootfs*, as shown in the example dump below:

The compiled kernel modules are installed in *$ELINOS_PROJECT/kernel.rootfs*:

```
tschnuer@tslinux2:~/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/kernel.rootfs>
find
[...]
./lib/modules/2.6.15.7-ELinOS-387/misc/men_mdis_kernel.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_bbis_kernel.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_oss.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_dbg.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_desc.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_pld.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_pld_sw.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_id.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_id_sw.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_mbuf.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_smb_port.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_smb_port_io.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_chameleon.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_ll_canodin.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_bb_chameleon_pcitbl.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_bb_isa.ko
./lib/modules/2.6.15.7-ELinOS-387/misc/men_lx_frodo_sw.ko
tschnuer@tslinux2:~/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/kernel.rootfs>
..
```

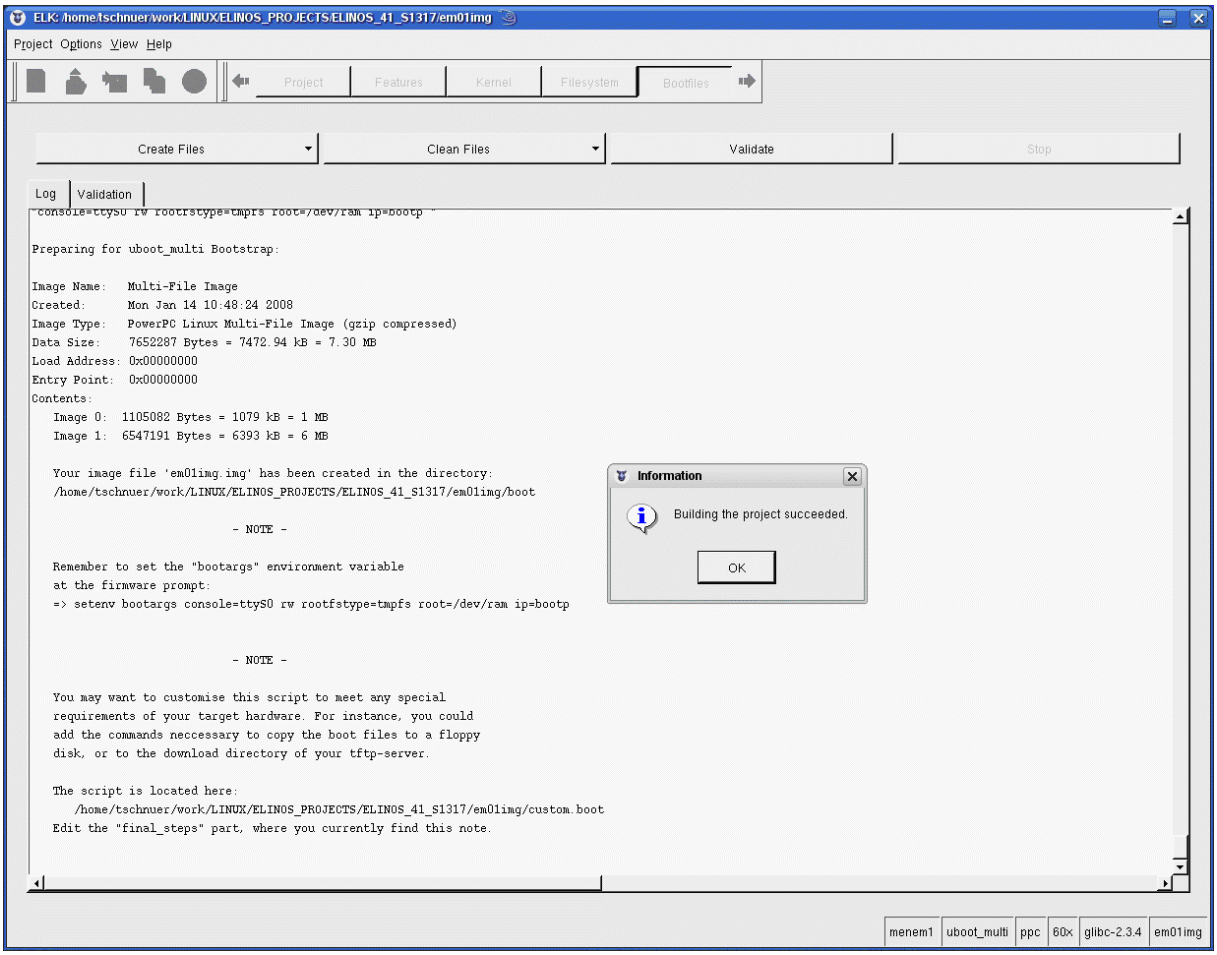
The binary MDIS descriptor files are copied into */etc/mdis* and the userspace tools to */usr/bin* (or any other directory given in the MDIS Wizard. The directory is assigned to environment variable *BIN_INSTALL_DIR* in *$ELINOS_PROJECT/src/mdis/Makefile*. (See the following lines in the Makefile.)

```
# The directory in which the user state programs are to be
# installed. Often something like /usr/local/bin. (relative to
# the target's root tree)
BIN_INSTALL_DIR = $(ELINOS_PROJECT)/app.rootfs/usr/bin
```

Therefore, on the used test system the files were installed to *$ELINOS_PROJECT/app.rootfs*:

```
tschnuer@tslinux2:~/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img> cd app.rootfs/
tschnuer@tslinux2:~/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/app.rootfs> find
[...]
./etc/mdis/bbmscan_1.bin
./etc/mdis/bbmscan_2.bin
./etc/mdis/cpu.bin
./etc/mdis/fpga.bin
./etc/mdis/uart_1.bin
./etc/mdis/uart_2.bin
./etc/mdis/can_1.bin
./etc/mdis/can_2.bin
[...]
./lib/libusr_oss.so
./lib/libusr_utl.so
./lib/libmdis_api.so
./lib/libmscan_api.so
./usr/bin/mdis_createdev
./usr/bin/mscan_alyzer
./usr/bin/mscan_loopb
./usr/bin/mscan_menu
./usr/bin/mscan_qstest
```

So, after the generated files were installed into ELinOS's project tree directories, it is necessary to have them on the running target as well. The easiest way to do this is to either execute "Create Files" in the graphical ELK configurator or to execute *make boot* in the ELinOS project's top directory (in this example: *~/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img*).


ELK: /home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img
Project Options View Help
Project
Features
Kernel
Filesystem
Bootfiles
Create Files
Clean Files
Validate
Stop
Log
Validation
Preparing for uboot_multi Bootstrap:
Image Name: Multi-File Image
Created: Mon Jan 14 10:48:24 2008
Image Type: PowerPC Linux Multi-File Image (gzip compressed)
Data Size: 7652287 Bytes = 7472.94 kB = 7.30 MB
Load Address: 0x00000000
Entry Point: 0x00000000
Contents:
Image 0: 1105082 Bytes = 1079 kB = 1 MB
Image 1: 6547191 Bytes = 6393 kB = 6 MB
Your image file 'em01img.img' has been created in the directory:
/home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/boot
- NOTE -
Remember to set the "bootargs" environment variable
at the firmware prompt:
=> setenv bootargs console=ttyS0 rw rootfstype=tmpfs root=/dev/ram ip=bootp
- NOTE -
You may want to customise this script to meet any special
requirements of your target hardware. For instance, you could
add the commands neccessary to copy the boot files to a floppy
disk, or to the download directory of your tftp-server.
The script is located here:
/home/tschnuer/work/LINUX/ELINOS_PROJECTS/ELINOS_41_S1317/em01img/custom.boot
Edit the "final_steps" part, where you currently find this note.
Information
Building the project succeeded.
OK
menem1
uboot_multi
ppc
60x
glibc-2.3.4
em01img

The screen shot shows how the root file system creation step looks like when successfully finished.

The complete build log file can be found in the MDIS example ZIP file, under *EM1_onchipCan/completeBuildLog*.

(See note on page 3 for hints on download of the example projects.)

2.1.3 Running the MSCAN Examples

When the root file system is equipped with the driver modules (here a RAM image using boot strategy *uboot_multi* is used) it is necessary to ensure the target's root file system is the modules can be loaded and accessed:

```
/#modprobe men_ll_canodin
MEN men_oss init_module
MEN men_desc init_module
MEN men_dbg init_module
MEN BBIS Kernel init_module
MEN MDIS Kernel init_module
MEN men_ll_canodin init_module
/#
/#modprobe men_bb_chameleon_pcitbl
MEN men_chameleon init_module
MEN men_bb_chameleon_pcitbl init_module
/#
/#m_open can_1
open can_1
 MEN men_bb_isa init_module
path=3 opened
close path
/#
/#
/#mscan_loopb can_1
=== Performing test a: Basic Tx/Rx                              (Run 1/1) ===
Test a: ok
=== Performing test b: Tx chronological                         (Run 1/1) ===
DRIVER INTERNALS:
$Id: mscan_drv.c,v 1.10 2005/03/24 10:18:28 kp Exp $
MSCAN REGS:
 CTL0=10 CTL1=a0
 RFLG=00 TFLG=07 TIER=00
MSCAN DRIVER:
 txPrio: -1 -1 -1
MESSAGE OBJECTS:
 OBJ 0: rx
  totEntries: 10 filled: 0
 OBJ 1: tx
  txbUsed: 0 txNxtPrio 4 txSentPrio 3
  totEntries: 100 filled: 0
 OBJ 2: rx
  totEntries: 100 filled: 0

Test b: ok
=== Performing test c: Rx filter                                (Run 1/1) ===
 Waiting transmit complete
 Verifying frames
Test c: ok
=== Performing test d: Rx/Tx signals                            (Run 1/1) ===
Test d: ok
=== Performing test e: Rx FIFO overrun                          (Run 1/1) ===
Test e: ok
-------------------------------------------------
TEST RESULT: 0 errors
Max irqtime=0 (internal ticks)
/#
```

```
/#
/#mscan_loopb can_2
=== Performing test a: Basic Tx/Rx                                  (Run 1/1) ===
Test a: ok
=== Performing test b: Tx chronological                             (Run 1/1) ===
DRIVER INTERNALS:
$Id: mscan_drv.c,v 1.10 2005/03/24 10:18:28 kp Exp $
MSCAN REGS:
 CTL0=10 CTL1=a0
 RFLG=00 TFLG=07 TIER=00
MSCAN DRIVER:
 txPrio: -1 -1 -1
MESSAGE OBJECTS:
 OBJ 0: rx
  totEntries: 10 filled: 0
 OBJ 1: tx
  txbUsed: 0 txNxtPrio 4 txSentPrio 3
  totEntries: 100 filled: 0
 OBJ 2: rx
  totEntries: 100 filled: 0

Test b: ok
=== Performing test c: Rx filter                                    (Run 1/1) ===
 Waiting transmit complete
 Verifying frames
Test c: ok
=== Performing test d: Rx/Tx signals                                (Run 1/1) ===
Test d: ok
=== Performing test e: Rx FIFO overrun                              (Run 1/1) ===
Test e: ok
------------------------------------------------
TEST RESULT: 0 errors
Max irqtime=0 (internal ticks)
/#
```

2.1.4 Troubleshooting

This example was tested using ELinOS 4.1 (CD Release S1317) and an EM1A CPU board.

It should be possible to do an *m_open can_1* or *m_open can_2* command as in the dump above. However, if you are unable to perform the commands shown above or the m_open call returns with an error, some prerequisites should be checked right after booting from the shell:

Did the *make install* command integrate the driver files correctly into the root file system?

Check if folder */lib/modules/<kernelversion>/misc/* is filled with the previously compiled driver kernel modules such as *men_ll_canodin.ko* etc. Execute the following command to check this:

```
/# ls -la /lib/modules/2.6.15.7-295/misc/
```

The kernel version is the one that can also be retrieved from the command:

```
uname -r
```

Are the descriptor files located in folder */etc/mdis/* ?

Execute the following command to check this:

```
/# ls -la /etc/mdis/
```

There have to be some files with extension *.bin*, like *can_1.bin* and *can_2.bin*.

Was device node */dev/mdis* created properly?

Execute the following command to check this:

```
/# ls -la /dev/mdis/
```

The device node with major number 252 and minor 0 must exist. It is the device node through which the MDIS API communicates with MDIS device drivers. If it does not exist, it can be created with a call of

```
/# mdis_createdev
```

or directly through command

```
/# mknod /dev/mdis c 252 0
```

Were the kernel modules loaded using *modprobe*?

This is necessary prior to the call of *m_open can_1* because otherwise there is no driver available to handle the *m_open* call. The commands should result in the module loading and initialization as shown here:

```
/#modprobe men_ll_canodin
MEN men_oss init_module
MEN men_desc init_module
MEN men_dbg init_module
MEN BBIS Kernel init_module
MEN MDIS Kernel init_module
MEN men_ll_canodin init_module
/#
/#modprobe men_bb_chameleon_pcitbl
MEN men_chameleon init_module
MEN men_bb_chameleon_pcitbl init_module
```

When all these prerequisites are fulfilled it should be possible without any problem to do a basic access to the *can_1* and *can_2* devices:

```
/#m_open can_1
open can_1
 MEN men_bb_isa init_module
path=3 opened
close path
/#
```

By the way, in this example the MDIS kernel driver automatically loads another module, men_bb_isa.ko, first. The kernel has to be compiled with support for kernel modules and automatic kernel module loading.

Basically the access to every MDIS device should be tested with m_open first before trying to start a more complex application.

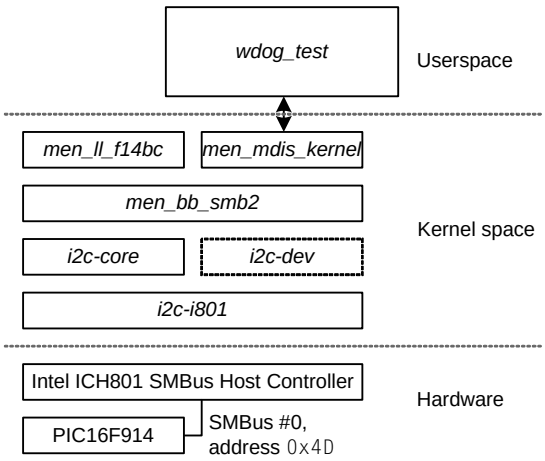
2.2 Watchdog/Board Controller on F14

This project demonstrates how to build an MDIS project with a ready-to-use *system.dsc* and Makefile (delivered). In the case of MDIS SMBus support this is necessary since the SMB2 library which is needed for this is not supported as a component in the MDIS Wizard yet.

The block diagram below shows the basic interaction between the user program and SMBus hardware and how the different kernel modules relate to each other.

The driver module *men_bb_smb2.ko* acts as the primary layer between the hardware drivers delivered by the Linux distribution (*i2c-i801.ko*, *i2c-core.ko* and *i2c-dev.ko*) and MEN's driver modules which use the MEN "SMB2" library. This library offers regular SMBus access functionality (byte/word reads and writes). The *men_bb_smb2.ko* module is basically a wrapper for the kernels *smbus_read/ write_xxx* functions and handles these SMB2 calls. Details about SMBus support in the Linux kernel can be found e.g. in */linux/Documentation/i2c/*.

Figure 1. *Relation of kernel drivers for SMBus access on F14*



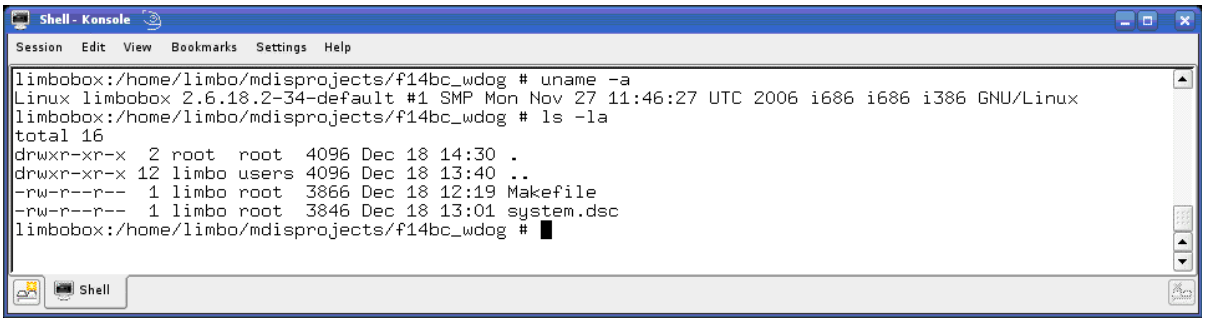
2.2.1 Prerequisites

For this example the standard MEN driver package 13Y007-06 was already included in the example projects archive. From this package the driver module *men_ll_f14bc.ko* is built and also the *wdog_test* program is part of the package. The installation of this package can be done in the MDIS Wizard, or the ZIP file can simply be unzipped in MDIS installation folder */opt/menlinux/*.

Also, the running kernel must of course have built-in SMBus support and the SMBus controller driver (usually *i2c-i801* on the F14) must be loaded.

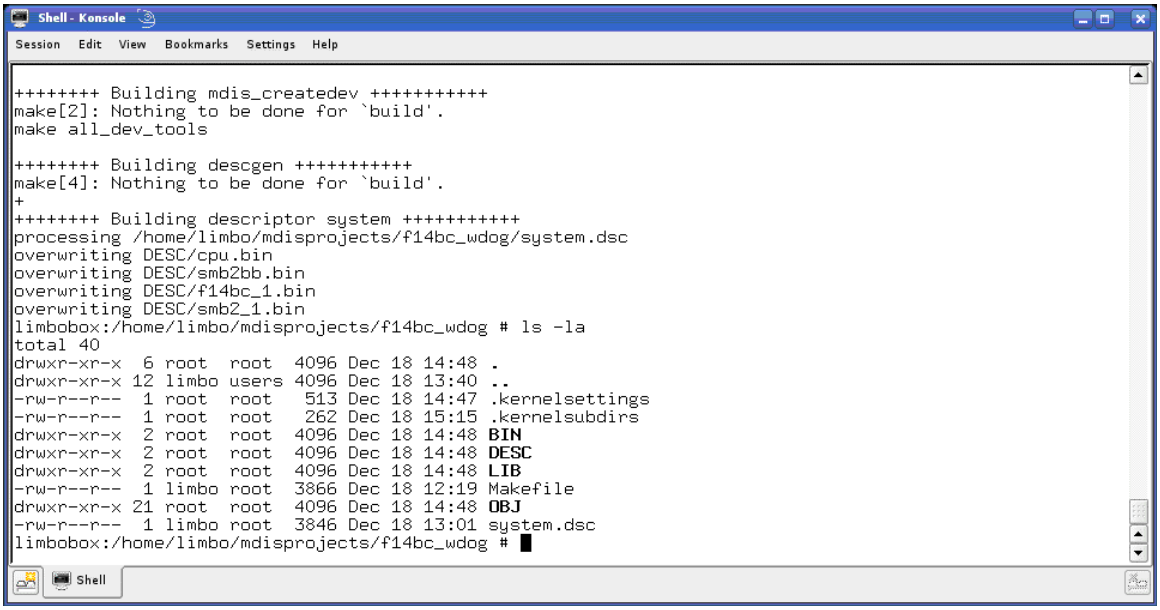
2.2.2 Copying the Files

Copy files *Makefile* and *system.dsc* from the example *tgz* file (subfolder *f14_example*) into a folder under your home directory. This example was tested with a SuSE 10.2 Installation.


Shell - Konsole
Session Edit View Bookmarks Settings Help
limbobox:/home/limbo/mdisprojects/f14bc_wdog # uname -a
Linux limbobox 2.6.18.2-34-default #1 SMP Mon Nov 27 11:46:27 UTC 2006 i686 i686 i386 GNU/Linux
limbobox:/home/limbo/mdisprojects/f14bc_wdog # ls -la
total 16
drwxr-xr-x 2 root root 4096 Dec 18 14:30 .
drwxr-xr-x 12 limbo users 4096 Dec 18 13:40 ..
-rw-r--r-- 1 limbo root 3866 Dec 18 12:19 Makefile
-rw-r--r-- 1 limbo root 3846 Dec 18 13:01 system.dsc
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
Shell

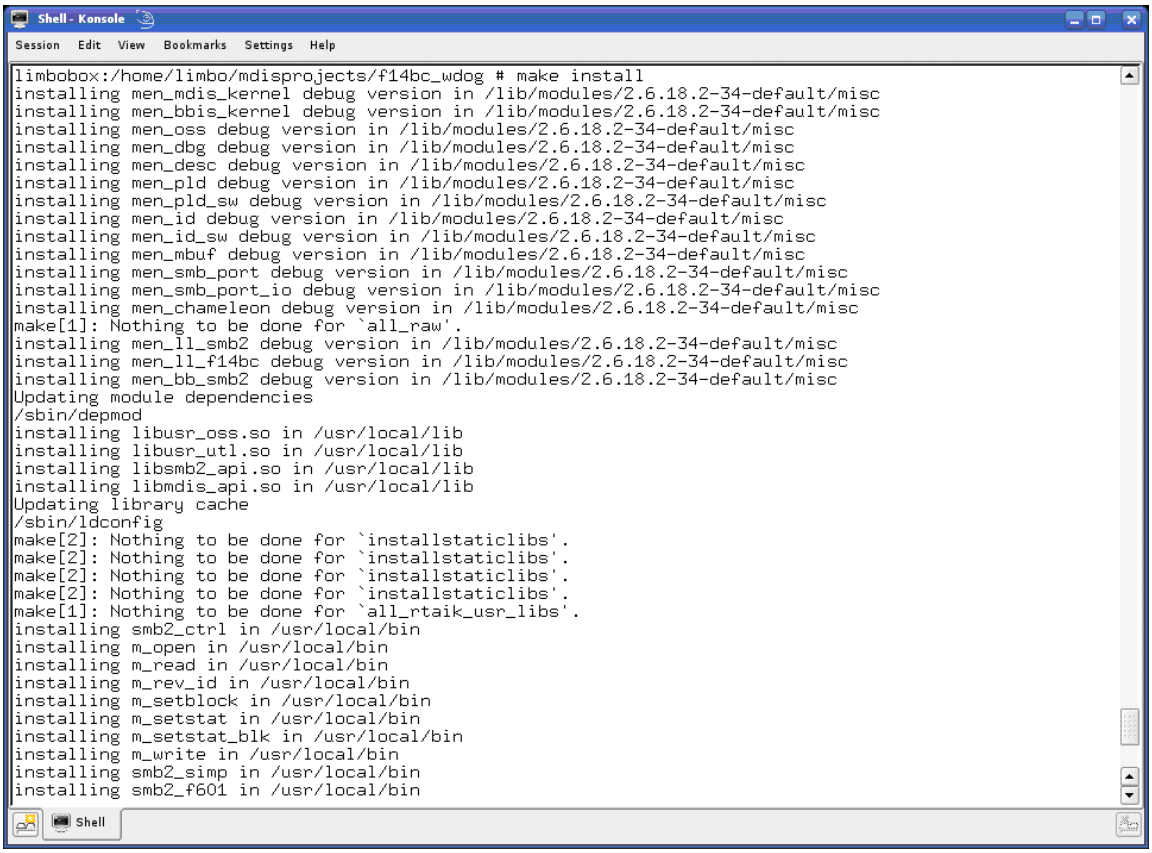
2.2.3 Building the Driver Files

Now, simply execute *make*. It is assumed that the necessary development packages with kernel headers for kernel development were installed. The dump below shows the last lines of the build process and the directory contents after the *make* call:


Shell - Konsole
Session Edit View Bookmarks Settings Help
++++++++ Building mdis_createdev ++++++++++
make[2]: Nothing to be done for `build'.
make all_dev_tools
++++++++ Building descgen ++++++++++
make[4]: Nothing to be done for `build'.
+
++++++++ Building descriptor system ++++++++++
processing /home/limbo/mdisprojects/f14bc_wdog/system.dsc
overwriting DESC/cpu.bin
overwriting DESC/smb2bb.bin
overwriting DESC/f14bc_1.bin
overwriting DESC/smb2_1.bin
limbobox:/home/limbo/mdisprojects/f14bc_wdog # ls -la
total 40
drwxr-xr-x 6 root root 4096 Dec 18 14:48 .
drwxr-xr-x 12 limbo users 4096 Dec 18 13:40 ..
-rw-r--r-- 1 root root   513 Dec 18 14:47 .kernelsettings
-rw-r--r-- 1 root root   262 Dec 18 15:15 .kernelsubdirs
drwxr-xr-x 2 root root 4096 Dec 18 14:48 BIN
drwxr-xr-x 2 root root 4096 Dec 18 14:48 DESC
drwxr-xr-x 2 root root 4096 Dec 18 14:48 LIB
-rw-r--r-- 1 limbo root 3866 Dec 18 12:19 Makefile
drwxr-xr-x 21 root root 4096 Dec 18 14:48 OBJ
-rw-r--r-- 1 limbo root 3846 Dec 18 13:01 system.dsc
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
Shell

2.2.4 Installing the Driver Files

Now, simply execute *make install*. The kernel modules and configuration files are copied to their appropriate locations. The kernel modules are installed to */lib/modules/<kernelversion>/misc/* and the user utilities and test programs go to */usr/local/bin*, see the snapshot below:


Shell - Konsole
Session Edit View Bookmarks Settings Help
limbobox:/home/limbo/mdisprojects/f14bc_wdog # make install
installing men_mdis_kernel debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_bbis_kernel debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_oss debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_dbg debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_desc debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_pld debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_pld_sw debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_id debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_id_sw debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_mbuf debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_smb_port debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_smb_port_io debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_chameleon debug version in /lib/modules/2.6.18.2-34-default/misc
make[1]: Nothing to be done for `all_raw'.
installing men_ll_smb2 debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_ll_f14bc debug version in /lib/modules/2.6.18.2-34-default/misc
installing men_bb_smb2 debug version in /lib/modules/2.6.18.2-34-default/misc
Updating module dependencies
/sbin/depmod
installing libusr_oss.so in /usr/local/lib
installing libusr_utl.so in /usr/local/lib
installing libsmb2_api.so in /usr/local/lib
installing libmdis_api.so in /usr/local/lib
Updating library cache
/sbin/ldconfig
make[2]: Nothing to be done for `installstaticlibs'.
make[2]: Nothing to be done for `installstaticlibs'.
make[2]: Nothing to be done for `installstaticlibs'.
make[2]: Nothing to be done for `installstaticlibs'.
make[1]: Nothing to be done for `all_rtaik_usr_libs'.
installing smb2_ctrl in /usr/local/bin
installing m_open in /usr/local/bin
installing m_read in /usr/local/bin
installing m_rev_id in /usr/local/bin
installing m_setblock in /usr/local/bin
installing m_setstat in /usr/local/bin
installing m_setstat_blk in /usr/local/bin
installing m_write in /usr/local/bin
installing smb2_simp in /usr/local/bin
installing smb2_f601 in /usr/local/bin
Shell

2.2.5 Accessing the Driver

Now the driver modules can be loaded using the *modprobe* command and an *m_open* call can be done:

```
/home/limbo/mdisprojects/f14bc_wdog # modprobe men_ll_f14bc
/home/limbo/mdisprojects/f14bc_wdog # m_open f14bc_1
open f14bc_1
path=3 opened
```

Please keep in mind that this *m_open* call consumes a noticable amount of time. This results from the kernel's SMBus core driver scanning all SMBus addresses for devices and passing them to the *men_bb_smb2* driver. In the kernel log */var/log/* messages this is shown. (You can use the *dmesg* command to display it.)

```
mk_ioctl: cmd=0x40604d05 arg=0xbfbce348
 MDIS_OPEN_DEVICE dev=f14bc_1 rtMode=0 persist=0 devdata=0804b170 devlen=244
brddata=00000000 brdlen=0
 board name = smb2bb
mk_ioctl exit: cmd=0x40604d05 ret=0 (-0x0)
mk_ioctl: cmd=0x40604d05 arg=0xbfbce348
 MDIS_OPEN_DEVICE dev=f14bc_1 rtMode=0 persist=0 devdata=0804b170 devlen=244
brddata=0804b3d0 brdlen=180
MK - InitialOpen: dev=f14bc_1 brd=smb2bb rtMode=0
 info: device f14bc_1 driver men_ll_f14bc slot 0
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x08
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x37
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x44
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x4c
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x4d
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x50
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x52
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x56
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x57
Adapter Nr. 0 'SMBus I801 adapter at 0500': probe SMBus client 0x69
 device addr spaces: 0 addr spaces
 device interrupt: not required
 device characteristic: AddrMode=0x0001, DataMode=0x000c
 process locking: lockMode=2
 board bustype=6, dev bustype=6 addrSpaceType=0
 board irq: info=0
LL - F14BC_Init
SMB2BB_ReadByteData : addr 0x4d cmdAddr 0x80: <6>read data = 46
SMB2BB_ReadByteData : addr 0x4d cmdAddr 0x81: <6>read data = 50
SMB2BB_ReadByteData : addr 0x4d cmdAddr 0x82: <6>read data = 46
SMB2BB_ReadByteData : addr 0x4d cmdAddr 0x83: <6>read data = 46
SMB2BB_ReadByteData : addr 0x4d cmdAddr 0x84: <6>read data = 46
SMB2BB_ReadByteData : addr 0x4d cmdAddr 0x85: <6>read data = 46
 PIC firmware revision (for rev. 2.0 and later) (6 bytes)
 <7>f734e41e+0000: 46 50 46 46 46 46                              FPFFFF
 first PIC firmware revision -> restricted functionality
LL - F14BC_GetStat: ch=0 code=0x1101
 device channels: 7 channels
 prepare lockMode LL_LOCK_CALL
```

```
mk_ioctl exit: cmd=0x40604d05 ret=0 (-0x0)
mk_release file=e404dbc0
 f14bc_1 useCount was 1
MK - FinalClose:
MK - FinalClose: device=f14bc_1
 deinit dev
LL - F14BC_Exit
 irq installed: 0
 deinit brd
 close board
detaching SMBus client: 0x08
detaching SMBus client: 0x37
detaching SMBus client: 0x44
detaching SMBus client: 0x4c
detaching SMBus client: 0x4d
detaching SMBus client: 0x50
detaching SMBus client: 0x52
detaching SMBus client: 0x56
detaching SMBus client: 0x57
detaching SMBus client: 0x69
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
```

So in this F14 board used for the test the 10 addressable SMBus locations were found. Often SMBus devices like EEPROMs consist of subsequent pages of 256 bytes whose addresses follow one by one, like `0x56` and `0x57`.

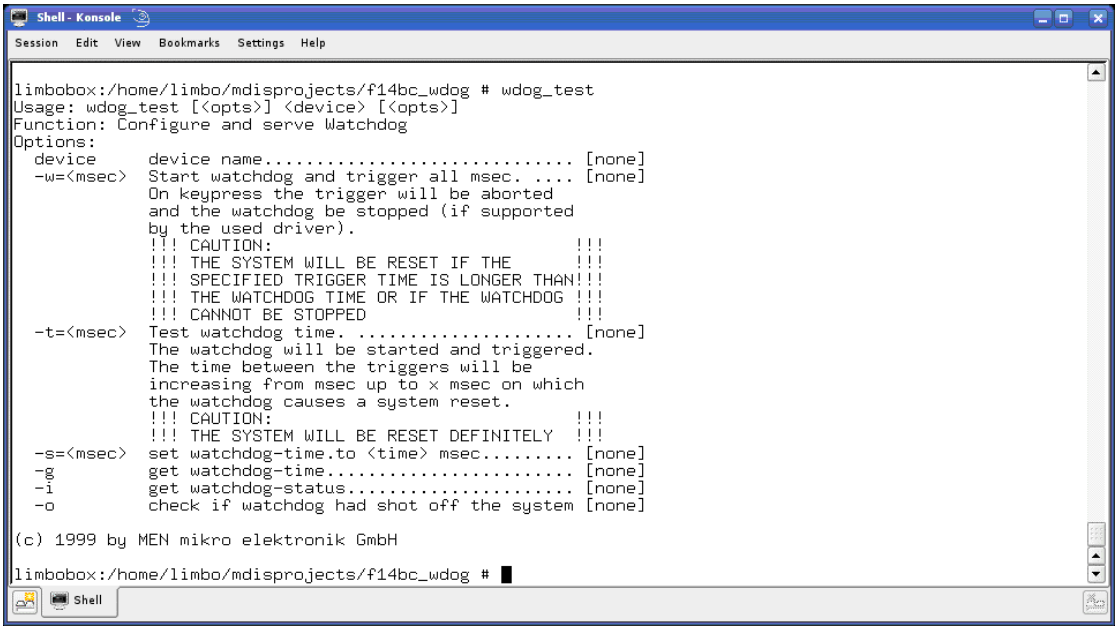
The PIC controller used on the F14 has device address `0x4D` (sometimes written as shifted-by-1 = `0x9A`). Linux uses 7-bit adresses internally.

2.2.6 Testing the Watchdog Functionality

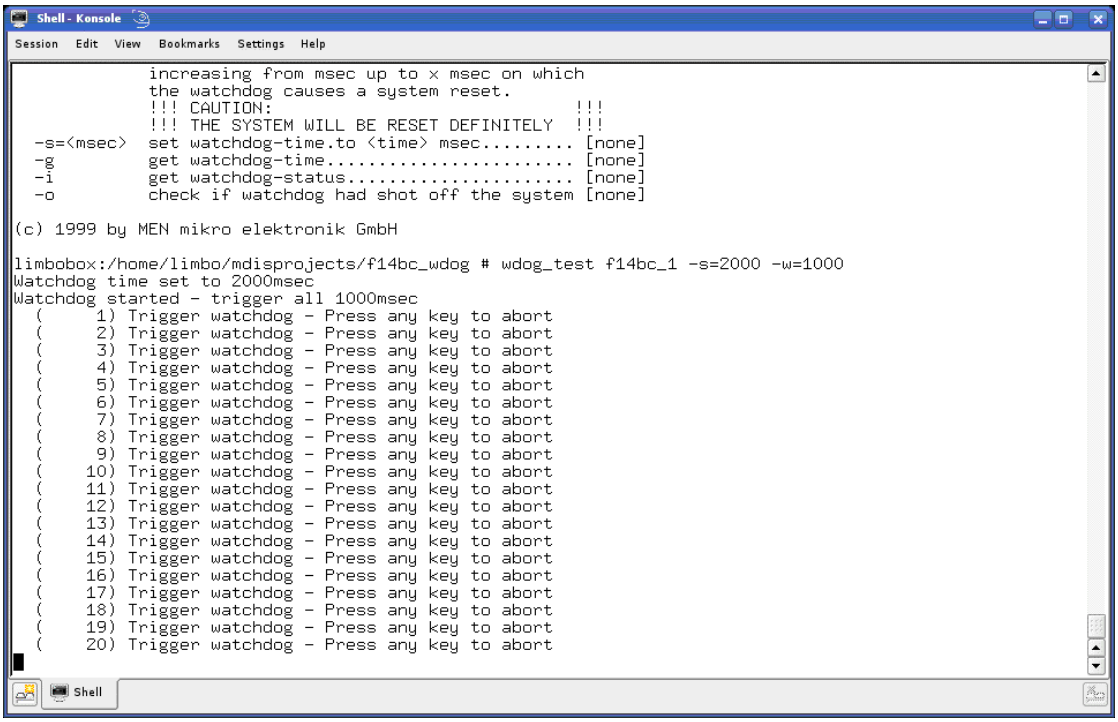
Finally the watchdog functionality shall be demonstrated.

Warning: No files, important data etc. should be left open or unsaved when you try this!

The *wdog_test* tool is used now. It serves as an example how to configure the watchdog:

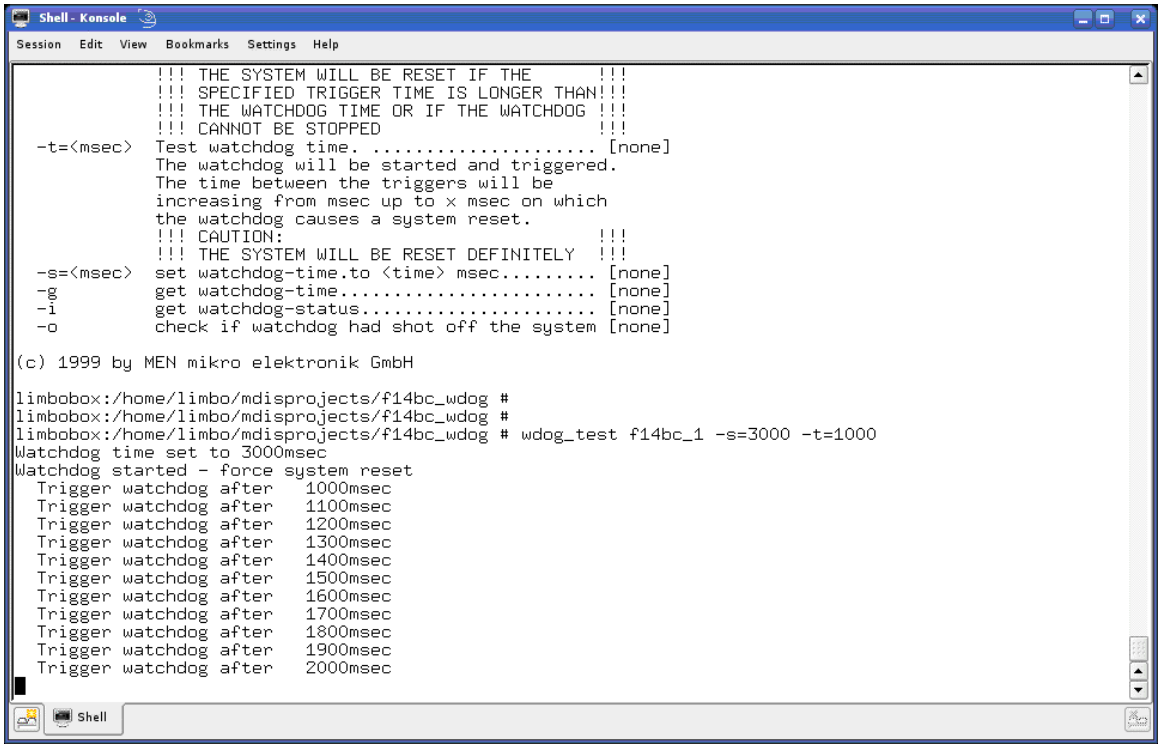

Shell - Konsole
Session Edit View Bookmarks Settings Help
limbobox:/home/limbo/mdisprojects/f14bc_wdog # wdog_test
Usage: wdog_test [<opts>] <device> [<opts>]
Function: Configure and serve Watchdog
Options:
device device name..... [none]
-w=<msec> Start watchdog and trigger all msec. .... [none]
On keypress the trigger will be aborted
and the watchdog be stopped (if supported
by the used driver).
!!! CAUTION: !!!
!!! THE SYSTEM WILL BE RESET IF THE !!!
!!! SPECIFIED TRIGGER TIME IS LONGER THAN!!!
!!! THE WATCHDOG TIME OR IF THE WATCHDOG !!!
!!! CANNOT BE STOPPED !!!
-t=<msec> Test watchdog time. ..... [none]
The watchdog will be started and triggered.
The time between the triggers will be
increasing from msec up to x msec on which
the watchdog causes a system reset.
!!! CAUTION: !!!
!!! THE SYSTEM WILL BE RESET DEFINITELY !!!
-s=<msec> set watchdog-time.to <time> msec..... [none]
-g get watchdog-time..... [none]
-i get watchdog-status..... [none]
-o check if watchdog had shot off the system [none]
(c) 1999 by MEN mikro elektronik GmbH
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
Shell

Now we set the watchdog timeout to 2000 msec and trigger every 1000msec:


Shell - Konsole
Session Edit View Bookmarks Settings Help
increasing from msec up to x msec on which
the watchdog causes a system reset.
!!! CAUTION: !!!
!!! THE SYSTEM WILL BE RESET DEFINITELY !!!
-s=<msec> set watchdog-time.to <time> msec..... [none]
-g get watchdog-time..... [none]
-i get watchdog-status..... [none]
-o check if watchdog had shot off the system [none]
(c) 1999 by MEN mikro elektronik GmbH
limbobox:/home/limbo/mdisprojects/f14bc_wdog # wdog_test f14bc_1 -s=2000 -w=1000
Watchdog time set to 2000msec
Watchdog started - trigger all 1000msec
(1) Trigger watchdog - Press any key to abort
(2) Trigger watchdog - Press any key to abort
(3) Trigger watchdog - Press any key to abort
(4) Trigger watchdog - Press any key to abort
(5) Trigger watchdog - Press any key to abort
(6) Trigger watchdog - Press any key to abort
(7) Trigger watchdog - Press any key to abort
(8) Trigger watchdog - Press any key to abort
(9) Trigger watchdog - Press any key to abort
(10) Trigger watchdog - Press any key to abort
(11) Trigger watchdog - Press any key to abort
(12) Trigger watchdog - Press any key to abort
(13) Trigger watchdog - Press any key to abort
(14) Trigger watchdog - Press any key to abort
(15) Trigger watchdog - Press any key to abort
(16) Trigger watchdog - Press any key to abort
(17) Trigger watchdog - Press any key to abort
(18) Trigger watchdog - Press any key to abort
(19) Trigger watchdog - Press any key to abort
(20) Trigger watchdog - Press any key to abort
Shell

This will repeat forever, until the program is stopped.

Now we try to set a watchdog time and increase the trigger intervals until they exceed the watchdog time:


Shell - Konsole
Session Edit View Bookmarks Settings Help
!!! THE SYSTEM WILL BE RESET IF THE !!!
!!! SPECIFIED TRIGGER TIME IS LONGER THAN!!!
!!! THE WATCHDOG TIME OR IF THE WATCHDOG !!!
!!! CANNOT BE STOPPED !!!
-t=<msec> Test watchdog time. ..... [none]
The watchdog will be started and triggered.
The time between the triggers will be
increasing from msec up to x msec on which
the watchdog causes a system reset.
!!! CAUTION: !!!
!!! THE SYSTEM WILL BE RESET DEFINITELY !!!
-s=<msec> set watchdog-time.to <time> msec..... [none]
-g get watchdog-time..... [none]
-i get watchdog-status..... [none]
-o check if watchdog had shot off the system [none]
(c) 1999 by MEN mikro elektronik GmbH
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
limbobox:/home/limbo/mdisprojects/f14bc_wdog #
limbobox:/home/limbo/mdisprojects/f14bc_wdog # wdog_test f14bc_1 -s=3000 -t=1000
Watchdog time set to 3000msec
Watchdog started - force system reset
Trigger watchdog after 1000msec
Trigger watchdog after 1100msec
Trigger watchdog after 1200msec
Trigger watchdog after 1300msec
Trigger watchdog after 1400msec
Trigger watchdog after 1500msec
Trigger watchdog after 1600msec
Trigger watchdog after 1700msec
Trigger watchdog after 1800msec
Trigger watchdog after 1900msec
Trigger watchdog after 2000msec
Shell

Option -t increases the trigger time every 100ms, so some fractions of a second after the interval exceeded 3000 msec the screen turns black and BIOS shows up, proving watchdog functionality.

2.3 PP4 MVB Slave Board on F207 Carrier and F14 CPU

The PP4 PCI-104 card contains an MVB slave device which can be used in train applications. The typical use is to communicate with other MVB participants under control of a Master device. To communicate with the host the PP4 has a PCI interface. (See the PP4 user manual for details.)

2.3.1 Used Carrier Hardware

In this example the PP4 is plugged on an F207 CompactPCI carrier board. This carrier contains just a PCI2050 PCI-to-PCI bridge from Texas Instruments.

In terms of software this bridge is transparent, meaning that the only difference visible to software is the different PCI bus and device number for the PP4, depending e.g. which CompactPCI slot the F207 is plugged into. To see where the PP4 is located in your system use the *lspci* command as in this example dump from an F14:

```
root@vcc1:/ #lspci
00:00.0 Host bridge: Intel Corp. Mobile Memory Controller Hub (rev 04)
00:01.0 PCI bridge: Intel Corp. Mobile Memory Controller Hub PCI Express Port (rev 04)
00:02.0 VGA compatible controller: Intel Corp. Mobile Graphics Controller (rev 04)
[...]
04:0f.0 PCI bridge: Texas Instruments PCI2050 PCI-to-PCI Bridge
05:05.0 Bridge: Altera Corporation: Unknown device 000c
root@vcc1:/ #
root@vcc1:/ #exit
```

Here the PP4 is visible to the CPU on PCI bus 5, device ID 5 (shown in red). These values are important for the system.dsc file. The PCI vendor ID is from Altera (0x1172) and the device ID given by MEN is 0x000C.

2.3.2 Descriptor File *system.dsc*

The *system.dsc* file contains the necessary mapping so the MDIS kernel can find the PP4 in the system properly. The important lines (here for the dump above) are within the descriptor *pci_1* that describes the *men_bb_pci* pseudo PCI carrier board driver:

```
PCI_BUS_NUMBER = U_INT32 0x5        <-- equal to the PCI bus number from lspci
PCI_DEVICE_NUMBER = U_INT32 0x5     <-- the PCI Device ID from lspci
DEVICE_SLOT_0 = U_INT32 0x5         <-- same, PCI Device ID
```

These tags provide MDIS with the necessary information, since MDIS for Linux does not seek for PCI devices in a plug and play manner, but addresses them exactly with the given bus and device ID numbers. The *DEVICE_SLOT_0* tag refers to the same device ID.

In this first example the PCI bus number and device ID were equal by random. If for example the *lspci* dump on your machine shows the PP4 like this…

```
root@vcc1:/ #lspci
[. . .]
03:05.0 Bridge: Altera Corporation: Unknown device 000c
root@vcc1:/ #
root@vcc1:/ #exit
```

…then the matching entries in the *system.dsc* file would look as follows:

```
PCI_BUS_NUMBER = U_INT32 0x3
PCI_DEVICE_NUMBER = U_INT32 0x5
DEVICE_SLOT_0 = U_INT32 0x5
```

This example can be built solely from the Makefile and *system.dsc* file contained in the example's ZIP file. After the files are copied into a folder, e.g. *~/mdis_pp04*, the build can be done using *make* and *make install*. For example:

```
#~> mkdir pp04_mdis
#~> cd pp04_mdis
#~/ pp04_mdis > cp xxx/Makefile xxx/system.dsc .   (xxx is the original location)
#~/ pp04_mdis > make
[...]
#~/ pp04_mdis > make install
[...]
```

If building and installing was successful, the kernel modules can be loaded using *modprobe*:

```
modprobe men_ll_pp04
modprobe men_bb_pci
```

And a first open command using the MDIS tool *m_open* can be done, which should result in the following dump:

```
#~/mdis_pp04>m_open pp04_1
 open pp04_1
 path=3 opened
 close path
```

More internals can be displayed using the *dmesg* command:

```
MEN men_dbg init_module
MEN men_oss init_module
MEN men_desc init_module
MEN BBIS Kernel init_module
MEN men_bb_pci init_module
MEN MDIS Kernel init_module
MEN men_ll_pp04 init_module
assigned Mem Mapping (MCM4):
laPitStart 0x00000000
laPitLen   0x00002000
laPcsStart 0x00030000
laPcsLen   0x00008000
laDatStart 0x00010000
laDatLen   0x00010000
daPitStart 0x00002000
daPitLen   0x00002000
daPcsStart 0x00038000
daPcsLen   0x00008000
daDatStart 0x00040000
daDatLen   0x00010000
   llHdl->ma = 0xf9700000
   llHdl->mvbMcm = 4
   llHdl->llHdl->mvbIMR0DefaultMask = 0xf0c0
   llHdl->llHdl->mvbIMR1DefaultMask = 0x00e0 MVB_PerformDiagnose dprtest = 0xfffc
reading test sink: adr= 0x3ce0 ..<7>TST port = 0xa55a  Loopback test ok.
MVB_SetInitializationLevel: lvl = 1
   read SCR: 0x0701
   write SCR: 0x0701
MVB_SetupMemConfiguration
MVB_FormatTM
LL - PP04_GetStat: ch=0x00000000 code=0x1101 LL - PP04_SetStat: ch=0x00000000
code=0x1005 value=0x0
MVB_EnableIrq: irqFlag 0xf0c0 imrReg=0x00000fb8 en=0
MVB_EnableIrq: irqFlag 0x00e0 imrReg=0x00000fbc en=0 LL - PP04_SetStat: ch=0x00000000
code=0x1005 value=0x0
MVB_EnableIrq: irqFlag 0xf0c0 imrReg=0x00000fb8 en=0
MVB_EnableIrq: irqFlag 0x00e0 imrReg=0x00000fbc en=0 LL - PP04_Exit
MVB_SetInitializationLevel: lvl = 0
   read SCR: 0x0741
PP04 LL Cleanup
```

By doing an *m_open*, the PP4 performs already some internal testing, e.g. an internal loopback test. With a result as the one above the PP4 proves to be ready for usage as an MVB Slave together with an MVB Master.

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